Citation:

Janssen I, Katzmarzyk PT, Ross R. Body mass index is inversely related to mortality in older people after adjustment for waist circumference. *J Am Geriatr Soc.* 2005 Dec;53(12):2112-8.

PubMed ID: 16398895

Study Design:

Longitudinal Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the effects of body mass index (BMI) and waist circumference (WC) on mortality risk in elderly men and women with emphasis on the independent predictive value of these two variables.

Inclusion Criteria:

- Participants in the Cardiovascular Health Study (CHS)
- Age 65 and older
- Male or female
- Member of the Medicare eligibility list
- Community-living (not institutionalized)
- Did not require a proxy respondent

Exclusion Criteria:

- Those over aged 65
- Those that were institutionalized
- Those that required a proxy respondent

Description of Study Protocol:

Recruitment

Men and women were recruited from Forsyth County, NC, Washington County, MD, Sacramento County, CA, and Pittsburgh, PA. Participants were sampled from Medicare eligibility lists in each area.

Design: Longitudinal cohort study

- BMI and WC were compared to mortality rates. Subjects were followed for up to 9 years.
- Exposure variables (BMI and WC) and covariates (SES, gender, race, and others) were obtained from a baseline exam. The baseline exam consisted of a home interview and clinical exam. Information was obtained on demographics, medical history, smoking, physical activity, and socioeconomic status. The clinical exam included anthropometric measurements (height, weight, and WC) and a standardized clinical exam.
- Mortality rates were obtained from a variety of records.There was a 100% follow-up ascertainment of mortality status.
- Residents were stratified by gender, age, socioeconomic status,level of physical activity, presence of lung disease, cancer, and diabetes, presence of coronary heart disease, stroke, and CHF at baseline.

Blinding used (if applicable): not applicable

Intervention (if applicable): not applicable

Statistical Analysis:

- Mortality rates per 1000 person-years are reported for BMI, WC, and BMI-by-WC categories adjusted for gender and age using Cox proportional hazards regression.
- Cox regression models were used to estimate the adjusted relative risks of mortality associated with BMI alone, WC alone, or BMI and WC together.
- Several variables, including gender, age, socioeconomic status, smoking, physical activity, and disease states were included as covariates in the Cox models.
- Stratified Cox models were used to explore the potential moderating influence of gender, age, and disease states on the observed relationships.

Data Collection Summary:

Timing of Measurements:

The baseline exam was conducted between June, 1989 and June, 1990. The CHS cohort was followed annually for 9 years after the baseline exam.

Dependent Variables

- All-cause mortality as measured by reviews of obituaries, medical records, death certificates, and the US Center for Medicare and Medicaid Services healthcare utilization database for hospital stays.

Independent Variables

- Body mass index (BMI) as determined using a mathematical formula based on weight (to the nearest 0.5 pounds) and height (to the nearest 0.5 cm).
- Waist circumference (WC) as measured to the nearest 0.5 cm at the level of the umbilicus using a flexible tape.

Control Variables

- Gender
- Age

- Socioeconomic status
- Smoking
- Physical activity
- Disease states

Description of Actual Data Sample:

Initial N: 5200, 2263 males and 2937 females

Attrition (final N): as above

Age:Greater than 65. participants were divided into five subgroups for analysis (65- 70, 71-76, 77-82, 83-89, ≥ 90).

Ethnicity: 94.7% of the participants (4924) were white. Others were reported as black or "other".

Other relevant demographics:Most of the participants were either of moderate SES (34%) or high SES (25.6%). 13% were of very low SES, 9.8% low SES, 11% very high SES, and 6.6% unknown.

3089 of the participants were free of major disease. 1247 had prevalent CVD.

Anthropometrics

Location: Participants were from Forsyth County, NC, Washington County, Maryland, Sacramento County, California, and Pittsburgh, PA.

Summary of Results:

Key Findings:

- BMI and WC were both negative predictors of mortality when examined individually
- When BMI and WC were measured simultaneously, BMI was a negative predictor of mortality and WC was a positive predictor of mortality.
- After controlling for WC, mortality risk decreased 21% for every standard deviation increase in BMI.
- After controlling for BMI, mortality risk increased 13% for every standard deviation increase in WC.
- The weighted evidence suggests that abdominal fat depots are more strongly related to morbidity than peripheral fat depots.

All-Cause Mortality Using Prediction Models with Body Mass Index (BMI) Alone, Waist Circumference (WC) Alone, or Both BMI and WC.

Group	BMI Alone	WC Alone	BMI and WC BMI	BMI and WC WC
All subjects (n = 5200)	0.88(0.84-0.93)	0.94(0.89-0.99)	0.81(0.74-0.89)	1.12(1.02-1.22)
Male (n=2263)	0.89(0.82-0.96)	0.94(0.87-1.03)	0.77(0.67-0.89)	1.19(1.02-1.40)
Female (n=2937)	0.88(0.88-0.95)	0.93(0.86-0.99)	0.83(0.74-0.99)	1.07(0.95-1.20)

Age				
65-74(n=3400)	0.88(0.81-0.95)	0.97(0.89-1.05)	0.76(0.66-0.86)	1.21(1.06-1.40)
≥75(n=1800)	0.86(0.80-0.92)	0.93(0.87-1.00)	0.80(0.71-0.90)	1.10(0.97-1.24)
Free of major disease (n=3089)	0.93(0.85-1.01)	0.95(0.88-1.04)	0.90(0.78-1.02)	1.04(0.91-1.20)
CVD (n=1247)	0.88(0.81-0.96)	0.93(0.86-1.02)	0.80(0.70-0.93)	1.13(0.97-1.32)

Other Findings:

- A distinct BMI and WC classification system is required for older men and women.
- Weight loss should not necessarily be considered beneficial in overweight and obese elderly persons independent of age, sex, and health status.

Author Conclusion:

The authors conclude that in those aged 65 years of age and older, higher BMI is associated with lower mortality rates.

Higher levels of waist circumference were associated with greater mortality risk after consideration of BMI, whereas higher levels of BMI were associated with lower mortality risk after consideration of WC.

The patterns of association between BMI and WC and mortality were consistent for men and women, the young elderly and the oldest old, and relatively healthy and diseased older adults.

Reviewer Comments:

Large multicenter study. Authors note the following limitations:

- *Sample was 95% white*
- *Analyses were performed on the public access CHS database, which had collapsed BMI and WC values at the 5th and 95th percentiles*
- *All-cause mortality was the only outcome examined*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes

4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes

4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A

7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	???
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes